

A computer is any device that follows a series of instructions. These instructions, the program, tell the computer how to solve a problem or do a task. Tasks that computers can do include controlling machines, decoding information and solving mathematical problems. Today, many people and businesses have personal computers. These are useful for applications such as word processing, managing accounts and playing games.

In 1947 the American computer engineer Howard Aiken said that just six electronic digital computers would be needed for the whole United States. By 2002 the world computer industry had built its one-billionth personal computer, and another billion are expected by 2008. Computers are everywhere around us. Each day, for example, every person in the United States uses around 150 computers embedded in common items.

Computers have had a huge effect on how people go about their working and home lives. Items from dishwashers to CD-players have computers inside them. Most jobs involve computers in some way, whether it is for email and word-processing or more directly, such as scientific research. In the future computers will continue to change our lives in new and unexpected ways.

Mechanical computers

Computers have always used the best technology of when they were made. The first computers used our hands. Then they became mechanical with the invention of gears and machinery. Modern computers are purely electronic.

The abacus was the first computer. It was invented in Egypt around 500BC, and used string and beads to add and subtract numbers by hand.

Blaise Pascal, a 17th century French mathematician, and a German named G. W. von Leibniz built the first mechanical versions of the abacus. Instead of moving beads by hand, their machines had gear wheels that turned discs marked with numbers.

After the industrial revolution in the 18th century, many factories and farms used machines and engines. Charles Babbage, a 19th century British mathematician, had the idea of the analytical engine—a steam driven machine the size of a locomotive that would behave like a modern computer. Unfortunately, the machinery was too difficult to make and Babbage never finished his machine.

Other less ambitious attempts at making mechanical computers succeeded though. Hermann Hollerich, an American inventor, developed a counting machine to organize data from the 1880 U.S. census. Hollerith's company went through several mergers and in 1924 became the International Business Machines Corporation (IBM). IBM is now the largest computer retailer in the world with an annual turnover of around 20 billion dollars.

Did you know? The first programmer was Ada Lovelace, the daughter of the British poet Lord Byron?

The British mathematician and musician Ada Byron Lovelace spent many years working with Charles Babbage on how to program his analytical engine. She developed many programs for his machine, but unfortunately died before a working computer could be constructed.

Electronic computers

All computers now work by using electronic switches. At first these switches were made from vacuum tubes, fragile glass tubes that looked like light bulbs. More recent computers use transistors. A modern silicon chip can contain millions of transistors in an area the size of a fingernail.

The first electronic computer was built by the British to break the German ENIGMA cipher (code) during World War II. It was largely the idea of a mathematician from Cambridge University, Alan Turing.

The first properly programmable electronic computer was built in the United States just after the war. The ENIAC (Electronic Numerical Integrator and Calculator) had around 18,000 vacuum tubes and occupied 1,500 square feet of floor space.

In 1947 the American scientists John Barden and Walter Brattain invented the transistor. The transistor quickly replaced the vacuum tube, allowing computers to become much smaller and use less power. IBM built the first commercial computer using transistors in 1960. This computer, the IBM 7090, was the fastest computer in the world at that time.

After the transistor came the silicon chip. A silicon chip contains many electronic components, such as transistors and capacitors. In 1971 Intel corporation started selling the Intel 4004, a silicon chip that had all of the parts for a computer. About the size of a fingernail, this chip had as much power as ENIAC.

Personal computers

Today, the most common computer is the personal computers (PC). Personal computers are small, relatively cheap and are used by only one person at a time. The invention of the personal computer has led to the 'personal computer revolution', where now computers are used in almost all businesses and many homes.

The first widely available personal computer, the Altair 88000, was made in 1974. It had an Intel processor that was programmed by flicking switches on the front of the computer. People who bought the Altair mainly experimented with it as a hobby. Some of these people are now the owners of multi-billion dollar business empires selling computers and programs.

The personal computer industry began properly in 1977 when the U.S. company Apple Computers started selling the Apple II. This was the first

computer that was both cheap to buy and easy to use. The Apple computer quickly became popular in homes, businesses and schools.

In 1981 the computer giant IBM started selling its first personal computer, the IBM PC. It used an Intel processor and ran on software bought from Microsoft Corporation. The IBM PC quickly became the most popular personal computer in the world. Now all personal computers are named after the PC in the name of IBM's original personal computer.

Since the early 1980s, personal computers have been based on the IBM or Apple computers. In many ways, the huge variety and relative cheapness of computers today is from the competition between Apple and IBM. A recent Apple computer is the Apple Mac G4 Powerbook, which is around a thousand times faster than the original Apple II. Many other companies now make copies of the IBM PC, such as Compaq or Dell. It is even possible to build a cheap PC from parts bought from a catalogue.

How computers work

Computers work on a set of rules called programs. A rule might say something like 'if the letter A is pressed on the keyboard, put a letter A on the screen.' The program Microsoft Windows 2000, for example, has around 40 million such rules.

Programs are written by people and use a language based on English. Computers do not think in this language themselves though. There are other programs on a computer than change these rules into sequences of numbers that are processed by the computer and then acted upon.

In every computer is a Central Processor Unit (CPU), the computer's brain. The CPU inputs a sequence of numbers, performs calculations with them, and then outputs another sequence of numbers. Other programs then act on these output numbers to make the computer to do tasks, such as printing letters on the monitor screen.

How computers count

When most people speak or write a number they use the decimal system of counting. This is based on the numbers zero (0) to nine (9), which are called the ten decimal digits. The position of the digit says if it counts the amount of ones, tens, hundreds, and so on—for example, the number 632 means six hundreds plus three tens plus two.

Computers count with the binary number system. This is based on only two digits, zero (0) and one (1), which are called the two binary digits, or bits for short. The position of the bit now says if it counts the amount of ones, twos, fours, eights, and so on—for example, 10101 in binary is sixteen plus four plus one, or 13 in decimal. It is also useful to group eight bits into a byte that can count up to 11111111 or 255 in decimal

Computers count in binary because their central processor is made of many tiny electronic switches. When a switch is off the computer counts a zero, while when a switch is on the computer counts a one. Any machine that works by on and off signals or switches is called digital. Almost all digital machines have computer chips inside them.

Inside and outside a computer

There are three types of component in a typical personal computer: the central processing unit (CPU), the memory, and the input/output devices. These components are connected to a circuit board called the motherboard either by a slot inside the computer or an outside port into which a cable fits.

The CPU is the computer's brain. It does the calculations that make the computer work. The power of a CPU is described by the size of numbers that it adds, and how quickly it adds them. A modern 32-bit CPU adds numbers with 32 binary digits, or up to about four billion in decimal. A typical CPU might add two billion of these numbers per second, called two Gigahertz (GHz).

A computer's memory is where it stores the results of calculations from the CPU. There are two types of memory. Random access memory (RAM) is where the computer stores temporary information that it is currently using. Read only memory (ROM) is permanent memory for important information that never changes. The amount of memory a computer has is measured in bytes. Each byte can store a number from 0 to 255. A modern computer could have 512 million bytes of RAM storage, called 512 Megabytes (Mb).

Another type of memory is the computer's permanent storage space on its hard drive. This holds information such as programs and documents. Storage space, unlike RAM memory, is kept after the computer is turned off. It is also slower to use. A typical hard disk might hold 100 Gigabytes (GB), around 100 billion bytes of information.

Input/output devices, or peripherals, are how people interact with computers. Information enters the computer through input devices and leaves through output devices. All personal computers have a keyboard and mouse for entering information, and a monitor for displaying the output. Another way of transferring information is through a removable storage device, such as a floppy disk, compact disk (CD), or digital versatile disk (DVD). Like hard drives these store information, although the disks can also be inserted and removed. Most commercial programs now come on CD or DVD.

There are many kinds of input/output devices for your computer. Other common ones include: printers, for copying stored pictures and documents onto paper; scanners, for taking copies of written text and pictures; modems, for swapping information with other computers down a phone line; and speakers, for playing sound. New devices are invented every day as people find more uses for the computer. It is now even possible to connect a television, mobile phone and camera to a home computer.

Did you know? The central processor of a computer is the most complicated mass-produced device made by man.

Silicon crystals are cut into wafers less than one fortieth of an inch (one millimeter) thick by high-precision saws. The wafer is chemically treated and then light is shined through incredibly detailed templates to etch circuits onto the chip. Each wafer is then split into hundreds of separate computer chips.

Types of computer

Computers come in different shapes and sizes depending on their use. Some fill rooms, while others fit inside a mobile phone. As computers become more useful in our lives the types of computer become steadily more diverse. Few people are aware today of the many computers that make our lives easier.

Personal computers (PCs) are the most familiar computer. PCs are designed for one person to use at a time. Most come in one of two designs: the desktop, which has a separate keyboard, mouse and monitor; and the laptop, or notebook, which comes in one piece so it can be carried around. Businesses use personal computers for word processing, accounting, desktop publishing and managing information about the company. At home the most popular uses are playing games and searching the Internet.

Hand-held computers are portable computers small enough to hold in a hand. Other names for hand-held computers are personal digital assistants (PDAs), palmtops and pocket computers. Like laptops they come in one piece and can be carried around. Because they are so small, keyboards are difficult to use and many people use an electric light pen to write onto the screen. The most popular uses of hand-held computers are as diaries and address books.

Embedded computers are tiny computers inside many common appliances, such as microwave ovens, television sets and digital watches. They are the most common computer, although people are mostly unaware of them. Embedded computers make our lives easier by making everyday items simple to use. There are already more embedded computers on the planet than people, and they are becoming more widespread every day.

Mainframes are very large, fast, and expensive computers that many people use at a time. Typically, they will fill a room and cost millions of dollars. Their main use is in industry, banks, and scientific research.

Supercomputers are the fastest and most expensive computers. Their speed and power is phenomenal, some adding tens of trillions of numbers a second. Supercomputers are used for specialized problems that need huge amounts of mathematical calculation—for example, weather forecasting, nuclear research, or animated graphics.

Computer networks

A computer network is a group of linked computers that can exchange information. They allow people to send emails and use documents or programs on another computer. Several computers on the same network can also share common devices, such as printers and scanners.

There are two basic types of network: local area networks (LANs) and wide area networks (WANs). LANs connect several computers together so they can use the same printers or perhaps a large information store, called a server. WANs connect computers and LANs over large networks that span countries or continents. While LANs use cables between computers, WANs typically use a modem and phone line.

The Internet, or World Wide Web, is the largest network of computers. It connects millions of computers across the world. The amount of information on the Internet is staggering. It literally covers any subject from anywhere in the world.

The user interface

A user interface allows a person to tell the computer what to do. The most common method is a graphical user interface (GUI), which is a collection of symbols, or icons, on the computer screen. These symbols represent the documents and programs on a computer. GUIs are designed to be used with a mouse, a hand held device for moving a pointer around the screen. This combination of a mouse and GUI gives a simple way for making computers usable by almost anyone.

GUIs are an example of software. Software is the collection of programs that are used on the computer. In contrast, hardware is the actual machine and the devices connected to it. Any program is a list of instructions telling the computer what to do. Programmers write these instructions in a language that the computer understands—for example, Beginners Symbolic Instruction Code (BASIC).

There are two types of software: system software and application software. System software, or the operating system, makes the computer work and contains the main GUI. Most people use either Microsoft windows, Linux or the Mac O/S (for Apple computers). Application software is the collection of programs that are used to do tasks. Examples include Netscape navigator, for looking at the Internet; Microsoft word, for word-processing; and computer games.

Benefits of computers

Computers are a central part of our lives. Almost everyone who lives in an industrialized country is a computer user. CD-players, dishwashers, mobile phones, and most other modern-technology items have embedded computers inside them.

Most modern-technology items are designed with computer assisted design (CAD) software, and made in factories with computer operated robotic assembly lines. Shops take the money for the item with computer-operated tills, while the money comes from a bank account that is stored on a computer database. Recently, shoppers have also been using the Internet to buy from home.

Telecommunications technology such as mobile phones uses digital signals that are understood by computers. These digital signals are beamed around the world by satellites, which are also operated by computer. With this technology it is now possible to communicate almost anywhere in the world.

Many physical disabilities can be aided by computer technology. There are artificial limbs, speech synthesizers, and wheelchairs operated by computer. These are important in giving physically disabled people independence and control over their lives.

Scientists use computer technology to analyze and make models of data. Simulation programs can generate models of weather conditions for meteorologists, test designs of new aircraft and cars, or design new medicines and drugs.

Another use of computers is as an aid to learning. Educational software gives new ways of presenting information to children. Recently, high schools and colleges have also started training students in actual application programs such as word processing, database, spreadsheets, and desktop publishing.

Problems with computers

Computers, being machines, can go wrong. If a hard disk fails, all of the information on the computer is lost. This can be catastrophic for the business. To prevent this from happening many businesses have automated backup systems that copy important information to another computer each night.

There is also a growing 'digital divide' between people with computers and those who do not. Those who own computers find them easy to use and have access to their benefits. Meanwhile, those who are not familiar with computers can find them intimidating and miss out on jobs and entertainment.

Malicious programs that harm computers and destroy data are a growing problem. With the widespread use of email has come viruses, programs that infect a computer and send themselves to other computers. These can also damage the computer or look for confidential information, like credit card details. Trojan horses are another danger. They are disguised to look like an innocent program, but if used can do literally anything to a computer—they can even allow a stranger to take complete control of your computer.

Criminals are using computers for a new type of crime, called cybercrime. The FBI estimates that there are about 10 billion dollars of cybercrime a year. Cybercrimes include credit card fraud across the Internet, email scams and

terrorism. Cyberterrorists can overload telephone lines; disrupt air traffic control; and scramble the software used by banks, hospitals and other emergency services.

The future of computing

In 1965 the cofounder of Intel Corporation, Gordon Moore, made his famous statement that the processing power and memory of a computer doubles every 18 months. This law, now called Moore's law, has been true for the last 30 years and is expected to hold in the future.

By the year 2020 the circuits on a computer chip will be the size of atoms. Current techniques for making computer chips will no longer work. New materials and techniques will have to be used to make more powerful computers. One possibility is quantum computers that use quantum physics, the laws that describe atoms and molecules. Quantum computers would perform tasks that are impossible with conventional computers, such as instantly searching through immense amounts of information.

New uses will be thought of for the powerful computers of the future. Already, computers can make virtual reality settings. The computer simulates a three-dimensional world that is seen through goggles. Gloves allow the items in this world to be held or moved. In the future these virtual reality worlds will be completely realistic, opening up a new generation of computer games and realistic training simulations.

Another use of computer power is artificial intelligence (AI). This is when computers are programmed to perform tasks that would require intelligence when done by people. These tasks include playing chess, drafts or other games; understanding speech; and speaking language. As computers become more powerful, artificially intelligent systems will replace people in many parts of our lives.

Many artificially intelligent systems are designed as neural networks, computer programs that work in a similar way to the human brain. These neural networks can do many things that are currently done by humans, such as recognizing objects, reasoning and learning. The human brain is made of around ten billion neurons with several thousand connections to each neuron. If a computer were to have a similar neural network, it could be as intelligent or even more intelligent than a human.

Although it is impossible to predict the future, one thing is certain: computers will continue to change our lives in new and exciting ways. Technology has greatly improved over the last thirty years, and it will continue to do so in the future.

Did you know? A DNA computer would be billions of times more powerful than any computer today.

In the future it may be possible to make a computer from DNA, the material that stores the genetic plans for humans and other animals. DNA molecules

have already been used to solve difficult mathematical problems. Many scientists believe that DNA chips would be able to unravel the mysteries of complex life and produce a host of new drugs.